Monitoring of Lost River and Shortnose Suckers at Shoreline Spawning Areas in Upper Klamath Lake, 1999

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Executive Summary

In 1999, we sampled Lost River (*Deltistes luxatus*) and shortnose (*Chasmistes brevirostris*) suckers from 5 April to 17 June at five shoreline spawning locations in Upper Klamath Lake (UKL). Trammel nets were set to encompass identified spawning areas and were fished approximately 1-1.5 hours before sunset until 3 hours after sunset or until 20 or more fish were captured. A total of 808 Lost River and 19 shortnose suckers were captured from Sucker, Silver Building, Ouxy, and Boulder springs, and Cinder Flats. The majority of Lost River suckers were captured at Cinder Flats (35%) and Sucker Springs (34%), followed by Ouxy Springs (16%), Silver Building Springs (12%), and Boulder Springs (3%). Males dominated the catch at all sites, but the sex ratios at Cinder Flats and Silver Building Springs were particularly skewed towards males. We recaptured 32 Lost River suckers that had been tagged during previous years sampling efforts. All of these fish, with the exception of two fish tagged at Ball Point in July, were originally tagged during the spawning season at shoreline spawning areas in UKL. This information provides further evidence that distinct stocks of Lost River suckers exist based on spawning location (i.e., UKL and Williamson River). We also recaptured 23 Lost River suckers that were tagged in 1999 at shoreline spawning areas. Approximately half of these fish were recaptured at different locations than tagged indicating these fish were moving between spawning areas. The size of fish captured at shoreline spawning areas decreased as the spawning season progressed, although the decrease in size was not as dramatic as reported in previous years. A limited number of shortnose suckers were captured at shoreline spawning areas in 1999, with a majority

sampled after 1 May. Previous data for shortnose suckers at these sites is limited with respect to size, timing of spawning, sex composition, and relative numbers. Continuation of systematic sampling efforts at shoreline spawning areas will provide valuable information on the demographics and life history of Lost River and shortnose suckers utilizing these areas.

Acknowledgements

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Introduction

Severe water quality problems in Upper Klamath Lake (UKL) have led to critical fisheries concerns for the region. Historically, UKL was eutrophic but has become hypereutrophic (Goldman and Horne 1983) presumably due to land-use practices within the basin (USFWS 1993). As a result, the algal community has shifted to a monoculture of the blue-green algae *Aphanizomemon flos-aquae* and massive blooms of this species have been directly related to poor water quality episodes in UKL. The growth and decomposition of dense algal blooms in the lake frequently cause extreme water quality conditions characterized by high pH (9-10.5), widely variable dissolved oxygen (anoxic to supersaturated), and high ammonia concentrations (>0.5 mg/l unionized). In addition to water quality problems associated with *A. flos-aquae*, it is believed the loss of marsh habitat near the lake, timber harvest, removal of riparian vegetation, livestock grazing, and agricultural practices within the basin has contributed to hypereutrophic conditions. It is likely that these disturbances have altered the UKL ecosystem substantially enough to contribute to the near monoculture of A. *flos-aquae.* Investigations in 1913 documented the algal community as a diverse mix of blue-green and diatom communities, however, by the 1950's A. *flos-aquae* was dominant (USFWS 1993).

The Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) are endemic to the Upper Klamath Basin of California and Oregon (Moyle 1976). Declining population trends for both species were noted as early as the mid-1960's, however, the severities of the population declines were not evident until the mid-1980's. In 1988 the U.S. Fish and Wildlife Service listed both Lost River and shortnose suckers as endangered. Suspected reasons for their decline included damming of rivers,

dredging and draining of marshes, water diversions, hybridization, competition and predation by exotic species, insularization of habitat, and water quality problems associated with timber harvest, removal of riparian vegetation, livestock grazing, and agricultural practices (USFWS 1993).

The U.S. Geological Survey, Biological Resources Division (BRD) has been conducting field investigations on Lost River and shortnose suckers in UKL since 1994. The majority of these sampling efforts have focused on catching fish in UKL and the Lower Williamson River. Sampling in the Lower Williamson River focused on developing indices of relative abundance of Lost River and shortnose suckers. In 1999, Oregon State University continued sampling in the Lower Williamson River fishing trammel nets from April to August at four standardized locations.

In addition to sampling efforts in the Lower Williamson River, BRD crews conducted periodic sampling at several shoreline spawning areas on the east side of UKL. This sampling was beneficial because it provided information on species composition, size, and sex ratios of suckers utilizing these areas. However, temporal changes in abundance may have been missed because consistent sampling never occurred throughout the entire spawning season (Perkins et al., In preparation).

Recently, there has been increased concern on the effects of water level management in UKL on spawning suckers. Information is needed on the timing, relative abundance, and distribution of sucker spawning in UKL to make informed decisions with respect to management of lake elevation. In 1999, we conducted systematic trammel netting surveys at Sucker, Silver Building, Ouxy, and Boulder springs and Cinder Flats along the east shore of UKL. In addition, we sampled periodically at Barkley Springs

and Modoc Point to determine if suckers were utilizing these areas for spawning. This report summarizes data collected in 1999 on shoreline spawning populations of Lost River and shortnose suckers with emphasis on timing, species composition, sex ratios, and relative abundance.

Methods

We conducted systematic trammel netting surveys at five locations along the east shore of UKL (Figure 1). We began sampling at Cinder Flats, Sucker, Silver Building, and Ouxy springs in early April with Boulder Springs added to the list of sampling sites on 27 April. In addition to these sites, we periodically sampled at Barkley Springs and Modoc Point (Table 1). We attempted to sample each site twice per week although certain sites were only sampled once per week when catch rates of suckers were low (i.e., less than 5 fish per evening).

Trammel nets were fished for about 4 hours (approximately 1-1.5 hours before sunset until 3 hours after dark) or until we captured 20 or more fish. Nets used at individual sites varied in length from 15-30 m, were 1.8 m tall with two outer panels (30cm bar mesh), an inner panel (3.8 cm bar mesh), a foam core float line, and a lead core bottom line. Generally, we set 1-2 nets starting at the shoreline and extending out to encompass the perimeter of the identified spawning area. Nets were checked at approximately 1 hour intervals and captured fish were cut from the inner mesh panel and placed in a mesh cage and processed within 2 hours. Suckers were identified by species and sex, measured to the nearest mm (fork length), inspected for tags (both PIT and Floy tags), and examined for physical afflictions (e.g., presence of *Lernaea* spp. and lamprey

scars). If a sucker did not have a PIT tag, one was inserted with a hypodermic needle along the ventral surface 1-2 cm anterior of the pelvic girdle.

The catch per unit effort (CPUE) of adult Lost River suckers was calculated for individual sampling locations for each evening sampled. Because identified spawning areas varied in size we used different length trammel nets to encompass the spawning areas. We did not attempt to standardize CPUE based on length of trammel nets used at each location.

Results

We sampled shoreline spawning areas from 5 April – 17 June capturing a total of 808 Lost River suckers and 19 shortnose suckers from 5 sites (Table 1). Lost River and shortnose suckers were captured at Sucker Springs, Silver Building Springs, Ouxy Springs, and Cinder Flats, while only Lost River suckers were captured at Boulder Springs. No suckers were captured at Barkley Springs and Modoc Point (Table 1). The majority of Lost River suckers were captured at Cinder Flats (35%) and Sucker Springs (34%; Figure 2). Males dominated the catch at all sites and were generally smaller (mean length = 538 mm) than females captured (mean length = 596 mm). In particular, sex ratios (males to females) were most skewed at Cinder Flats and Silver Building Springs (Figure 3). Large females (> 650 mm) were captured at most sites, except Boulder Springs, and the size range of fish captured over time remained similar with the exception that a fewer large individuals (> 600 mm) were captured in the late sampling period (1 May – 17 June) as compared to the early sampling period (6-30 April; Figure 4; Appendix Figure A).

The catch of shortnose suckers was limited at all sites sampled. Most (12 of 19) of the shortnose suckers were collected at Sucker Springs, with 1-3 fish captured at Cinder Flats, Ouxy Springs, and Silver Building Springs (Table 1). We identified 8 males and 8 females during the sampling period and were unable to determine sex for three individuals. The mean size of shortnose suckers was 360 mm (range 289-528 mm) similar to data reported by Perkins et al. (In preparation) from Sucker, Silver Building, and Ouxy springs.

We observed the highest CPUE of Lost River suckers at Cinder Flats (mean CPUE= 12.7/h) followed by Sucker Springs (mean CPUE=6.0/h), Silver Building Springs (mean CPUE = 2.8/h), and Ouxy Springs (mean CPUE= 2.4/h) (Figure 5). On three occasions at Cinder Flats, 20 or more suckers were captured within an hour or less resulting in the termination of sampling for the evening. CPUE was calculated for sampling dates at Boulder Springs (mean CPUE= 1.4/h), although comparisons with other sites is not applicable because this site was not initially included in systematic sampling efforts. We did not calculate CPUE for shortnose suckers.

We captured a total of 32 Lost River and 2 shortnose suckers that were tagged during previous years sampling efforts. The majority (96%) of these fish was originally tagged at shoreline locations (Table 2), which is consistent with historical recapture data (Appendix Table A). Two Lost River suckers were originally tagged at Ball Point in UKL in July, after the spawning season. In addition, most Lost River suckers were recaptured before 1 May, including 15 fish that were collected at Sucker Springs during two sampling occasions in March (Figure 6). We also recaptured a total of 21 Lost River suckers that were tagged in 1999 at shoreline spawning areas. Approximately half of

these fish were recaptured at different areas than where they were tagged, indicating that some suckers are moving between spawning areas within the season (Table 3).

Discussion

Our sampling indicated the spawning period for Lost River suckers lasted from mid-March through the beginning of June at shoreline spawning areas in 1999. The catch of Lost River suckers was dominated by males at all sites sampled, particularly at Cinder Flats and Silver Building Springs. Perkins et al., (In preparation) reported skewed sex ratios at shoreline spawning locations following the fish kills that occurred in UKL from 1995-1997. However, the ratios we observed were considerably higher than those reported by Perkins et al., (In preparation). At this time we are unable to determine the reason for the sex ratios observed. It is possible that males remain longer at the spawning areas than females making them more vulnerable to capture. Perkins et al., (In preparation) observed spawning acts and reported that males remained near the actual site where spawning occurs while females move onto the spawning site only when ready to spawn. We captured 23 Lost River suckers twice in 1999 and all but one of these fish were males. However, it is difficult to determine if this percentage is due to males remaining at these sites longer than females or a reflection of the existing sex ratios.

Another possible explanation could be the large numbers of males in the catch are from the 1991-1993 year classes and females from these year classes have yet to be recruited into the adult population. The majority of males captured (81%) were between 475 - 574 mm. Age and growth information from Lost River suckers collected during the 1996-1997 fish kills indicate these fish would be between 5-9 years old (USGS, BRD,

unpublished data). Perkins et al., (In preparation) reported that male Lost River suckers migrating up the Williamson River begin to be recruited into the adult population starting at age 4+, while females did not begin to mature until age 7+ . These data were based on examining length frequency distributions and noting when fish from the 1991 year class, which is presumed to be a strong year class, began showing up in trammel net catches. Fish from the 1991 year class would have been age 8+ in 1999. Buettner and Scoppetone (1990) examined opercles from Lost River suckers collected during the 1986 fish kill in UKL and reported that individuals matured between 6-14 years of age with the peak being 9 years. It is possible that in the next few years more females from the 1991-93 year classes will be recruited into the adult population spawning at shoreline areas.

Our data provides additional evidence that distinct stocks of Lost River suckers may exist based on fidelity to spawning area. Of the 32 suckers we recaptured from previous years sampling efforts, all but two were originally tagged at shoreline spawning locations. The two fish that were not originally tagged at shoreline spawning locations were captured at Ball Point in July and were not presumed to be spawning in this location. Perkins et al. (In preparation) reported that of 316 Lost River and 11 shortnose suckers recaptured at shoreline spawning areas all were originally tagged at shoreline spawning locations. Continuation of systematic sampling at both shoreline spawning areas and the Williamson and Sprague rivers will continue to provide information on potential separation of spawning populations.

The majority of recaptured fish were tagged during the first half of our sampling efforts including 13 fish that were recaptured on 25 March while sampling with Larry Dunsmoor of the Klamath Tribes. Historically, the majority of sampling effort at

shoreline spawning locations occurred prior to 1 May, which may explain why most recaptures were collected during the early part of our sampling period. In future years, we plan to continue systematic sampling through June to determine if temporal aspects of spawning remain consistent between years.

The size of fish captured at shoreline spawning areas decreased as the spawning season progressed, particularly near the end of our sampling period, although the decrease was not as dramatic as reported by Perkins et al., (In preparation). It is possible that individual timing of Lost River sucker spawning is affected by size. Scoppettone et al., (1986) observed that smaller, younger cui-ui (Chasmistes cujus) at Pyramid Lake spawned at the end of the spawning season. We believe further investigation is needed to determine if differences in spawning timing among individuals is due to size or related to stock differences.

A limited number of shortnose suckers were captured in 1999. Sampling continued well into June and was sufficient to detect spawning concentrations of shortnose suckers at these sites. Based on previous sampling conducted at shoreline spawning areas, there appears to be a decreasing trend in the number of shortnose suckers captured at these sites (Perkins, et al., In preparation).

Our sampling efforts at shoreline spawning areas on the east side of UKL represents the first time these areas have been systematically sampled during the spawning season. Continuation of systematic sampling at these areas is important to provide information on species composition, timing and duration of spawning, fidelity to spawning areas, sex ratios, size distribution, and relative abundance. How these

population characteristics change over time will also provide important insights into the population stability of Lost River and shortnose suckers in UKL.

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Moyle, P.B. 1976. Inland fishes of California. University of California Press, Berkeley, CA.

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Table 1. Summary of the shoreline locations sampled in Upper Klamath Lake and the number of Lost River (LRS) and shortnose (SNS) suckers captured in 1999.

Sampling Location	Dates Sampled (range)	Number of days Sampled	Number of LRS Captured	Number of SNS Captured
Barkley Springs	4/5 – 4/27	4	0	0
Boulder Springs	4/27 – 6/17	11	21	0
Cinder Flats	4/6 – 6/17	19	284	2
Modoc Point	4/13 – 4/21	4	0	0
Ouxy Springs	4/6 – 6/17	20	129	3
Silver Bldg. Springs	4/5 – 6/17	19	100	2
Sucker Springs	4/5 – 6/17	20	274	13
Total			808	20

Table 2. Summary of the number of Lost River suckers recaptured from previous years sampling efforts at shoreline spawning locations in Upper Klamath Lake, 1999.

Site Originally Captured	Site Recaptured in 1999				
	Boulder Springs	Cinder Flats	Ouxy Springs	Silver Bldg. Springs	Sucker Springs
Boulder Springs	0	0	0	0	0
Cinder Flats	0	1	0	0	0
Ouxy Springs	0	0	0	0	1
Silver Bldg. Springs	0	0	1	1	2
Sucker Springs	0	4	1	0	19
Ball Point	0	2	0	0	0
Total	0	7	2	1	22

Table 3. Summary of the number of Lost River suckers recaptured at shoreline locations in Upper Klamath Lake originally tagged in 1999.

Site Originally Captured in 1999	Site Recaptured in 1999				
	Boulder Springs	Cinder Flats	Ouxy Springs	Silver Bldg. Springs	Sucker Springs
Boulder Springs	0	0	0	0	0
Cinder Flats	0	3	1	0	2
Ouxy Springs	0	1	0	1	0
Silver Bldg. Springs	0	3	0	1	1
Sucker Springs	0	1	3	0	6
Total	0	8	4	2	9

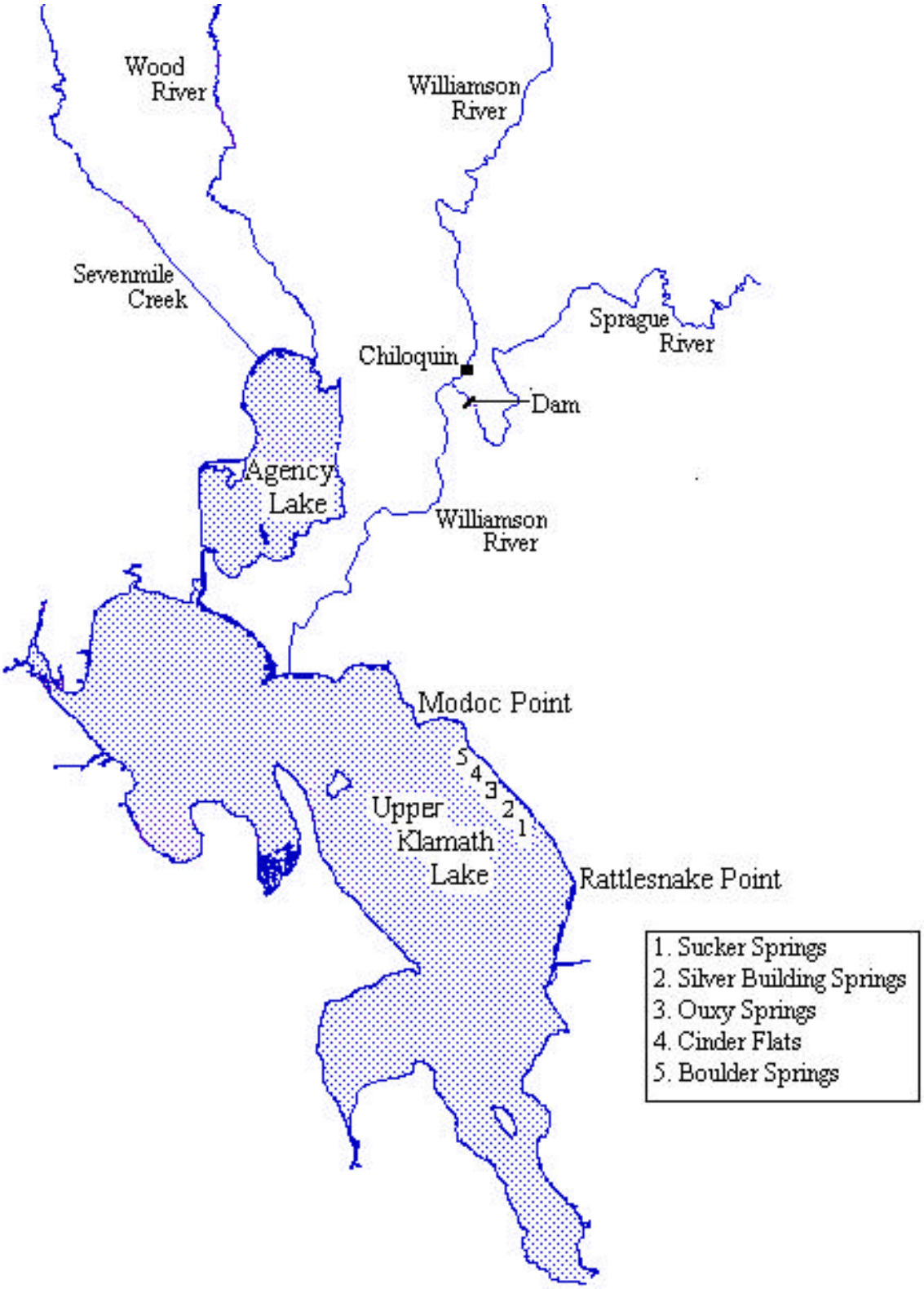


Figure 1. Map of Upper Klamath and Agency Lakes showing major tributaries and shoreline spawning areas sampled in 1999.

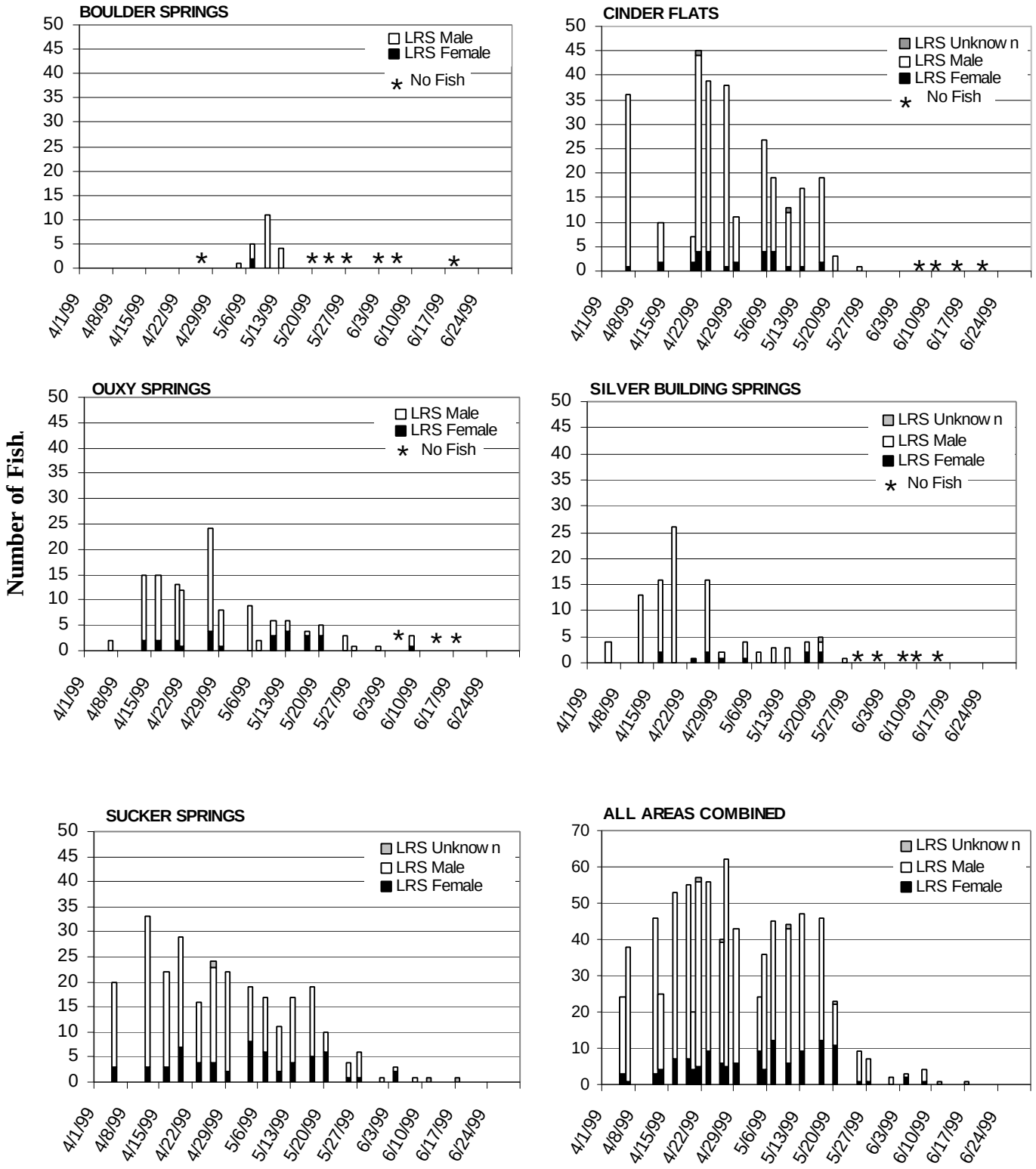


Figure 2. Summary of the number and sex of Lost River Suckers (LRS) captured at shoreline spawning areas in Upper Klamath Lake, 1999 sampling. LRS unknown refers to captured individuals in which sex could not be determined.

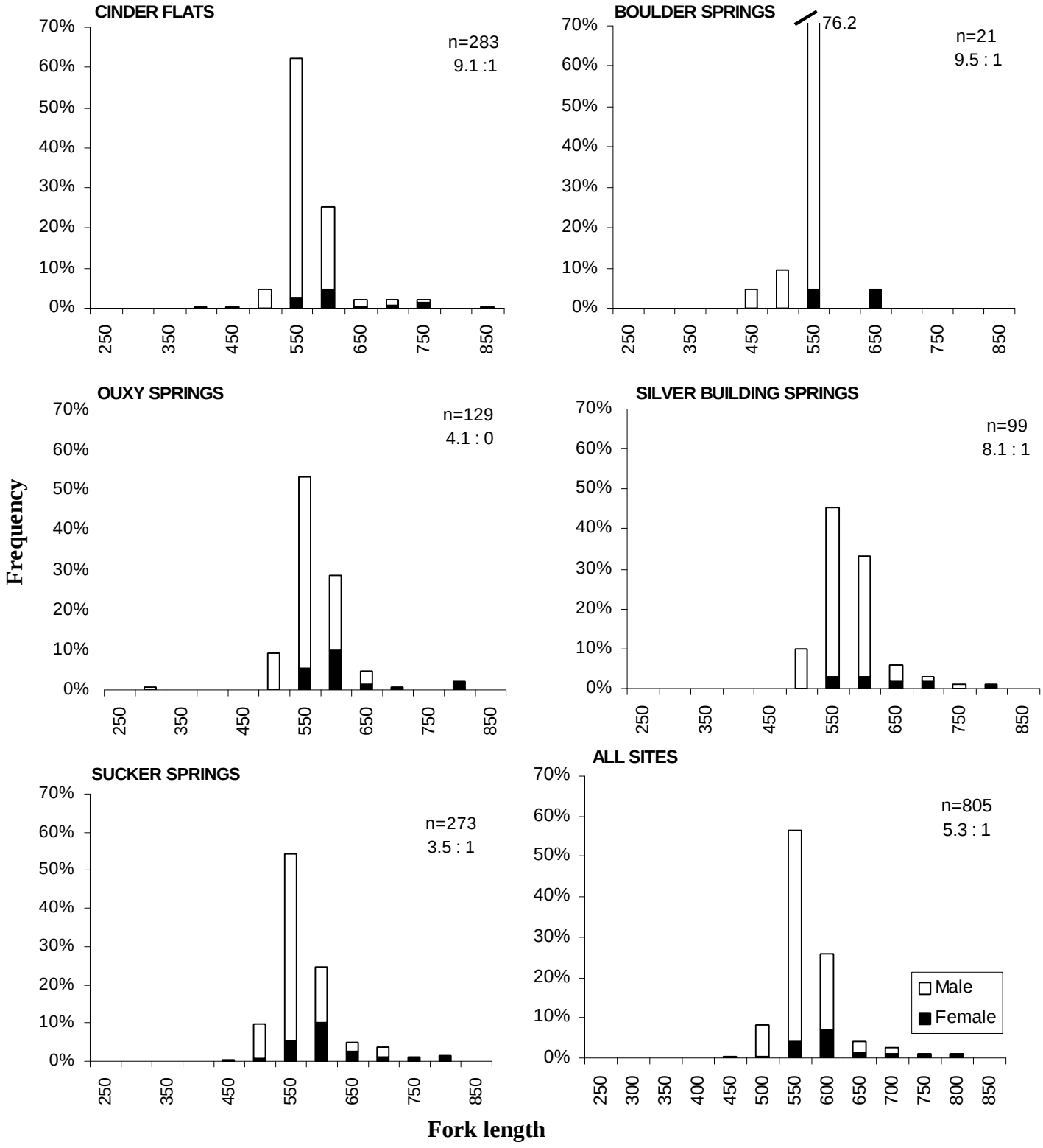


Figure 3. Length frequency histogram of male and female Lost River suckers (LRS) captured at shoreline spawning areas in Upper Klamath Lake, 1999. The total number of LRS captured in 1999 and ratio of males to females are presented in the upper right hand corner of each graph.

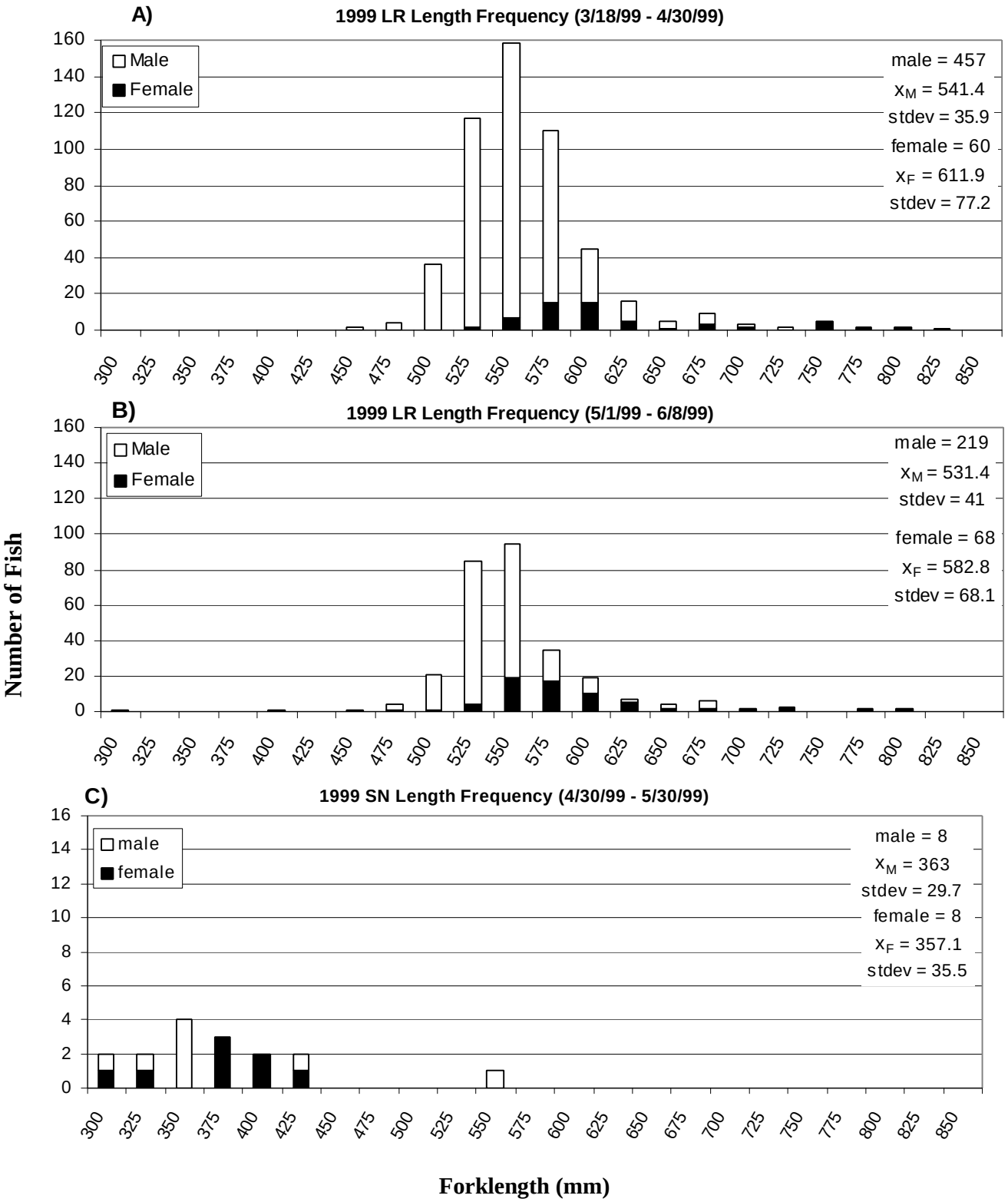


Figure 4. Length frequency for Lost River (LRS) and shortnose (SNS) suckers captured at shoreline spawning areas in Upper Klamath Lake, 1999. Graphs represent A) LRS caught from March 19-April 30, 1999, B) LRS caught from May 1-June 8, 1999, and C) SNS caught from April 30-May 30, 1999 (all SNS sampling days were combined due to limited SNS numbers). Four LRS with unknown gender were not included in the graph, two were caught before May 1st, and two after May 1st. Three SNS with unknown gender were not included in the graph.

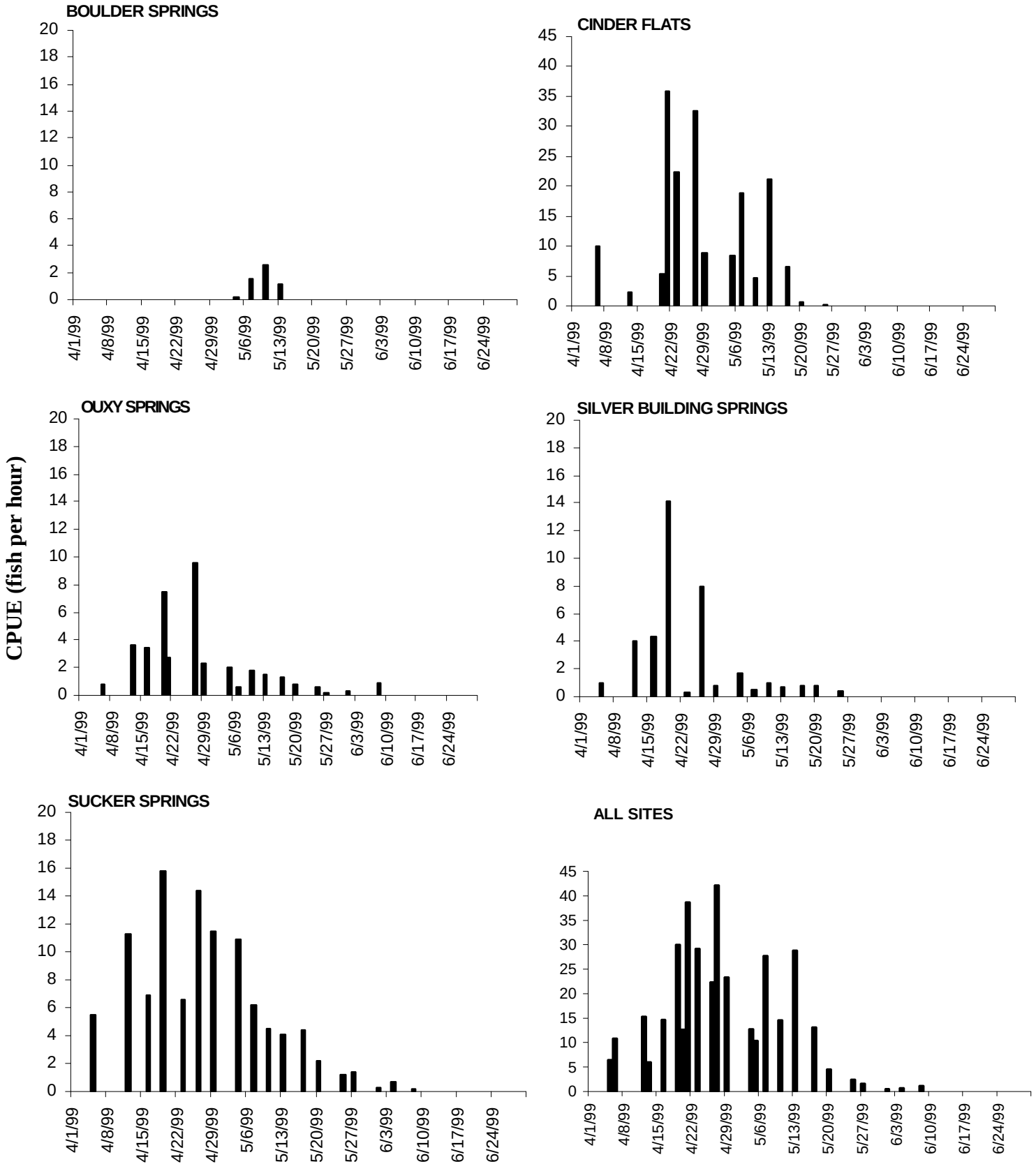


Figure 5. Summary of catch per unit effort (CPUE) of Lost River suckers at shoreline spawning areas in Upper Klamath Lake, 1999. Note change in scale for the Cinder Flats and the All Sites graphs.

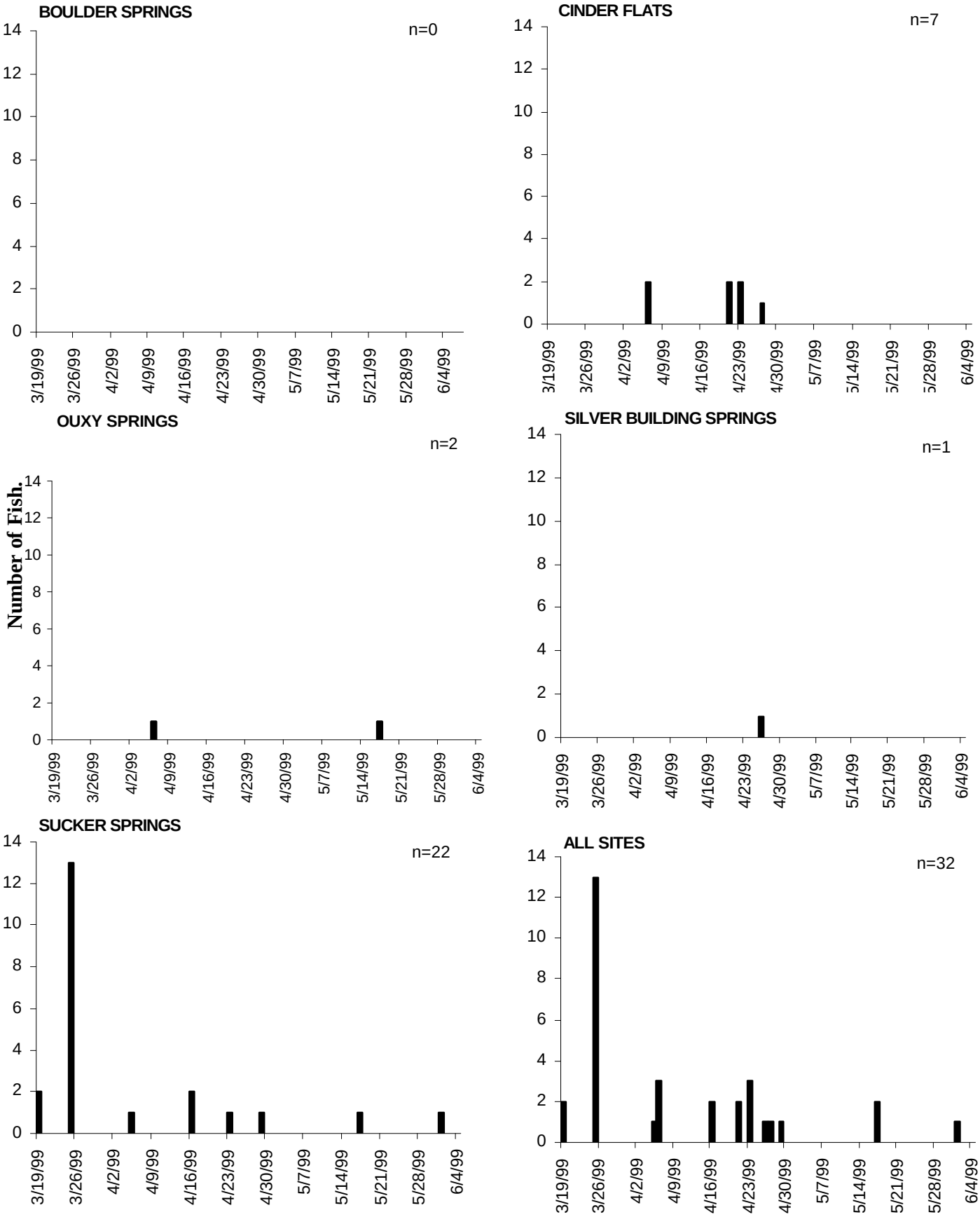


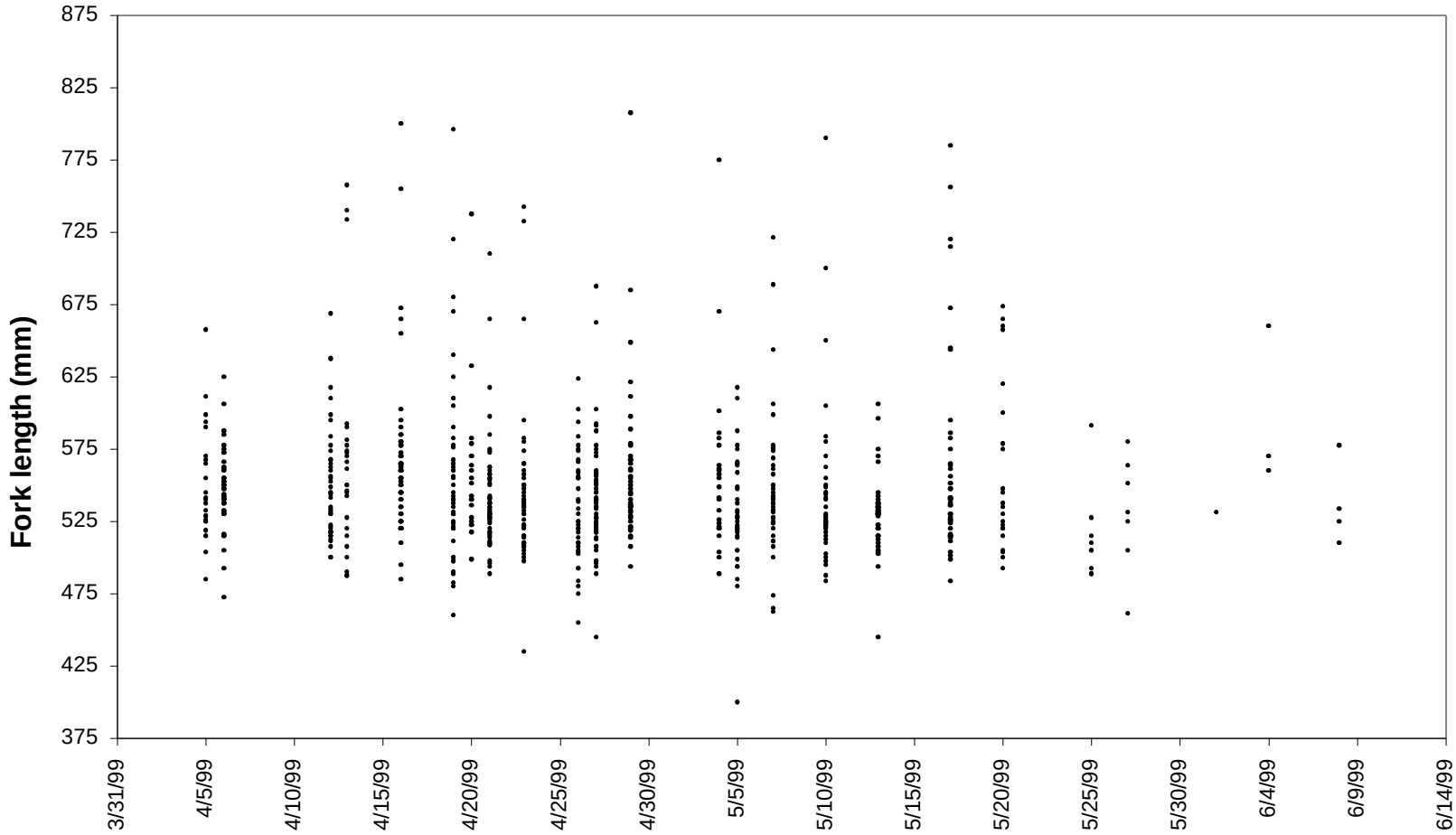
Figure 6. Summary of the number of Lost River suckers recaptured at shoreline spawning areas, Upper Klamath Lake, 1999. Recaptured fish were originally tagged betweeen 1988-1998.

Appendix Table A. Summary of recapture data for Lost River Suckers in the Upper Klamath Lake Basin from 1985-1999. Sampling was generally conducted from March-July of each year, although the emphasis in sampling was during the spawning period. Recapture data includes fish that were tagged with Floy and PIT tags.

	Site Last Recaptured								
Site Originally Captured	Cinder Flats	Ouxy Springs	Silver Bldg. Springs	Sucker Springs	Williamson River	Sprague River	Upper Lake	Middle Lake	Total
Cinder Flats	1	0	0	0	0	0	0	0	1
Ouxy Springs	0	1	0	0	0	0	0	0	1
Silver Bldg. Springs	0	1	1	6	0	0	0	1	9
Sucker Springs	4	1	6	288	1	0	0	0	300
Williamson River	0	0	0	4	6	1	0	1	12
Sprague River	0	0	0	0	3	13	0	0	16
Upper Lake	2	0	0	0	0	1	0	0	3
Middle Lake	0	0	0	0	0	0	0	0	0
Total	7	3	7	298	10	15	0	2	342

Appendix Table B. Summary of recapture data for shortnose suckers in the Upper Klamath Lake Basin from 1985-1999. Sampling was generally conducted from March-July of each year, although the emphasis in sampling was during the spawning period. Recapture data includes fish that were tagged with Floy and PIT tags.

	Site Last Recaptured									
Site Originally Captured	Ouxy Springs	Silver Bldg. Springs	Sucker Springs	Williamson River	Sprague River	Lower Lake	Middle Lake	Upper Lake	Reeder Road Bridge	Total
Ouxy Springs	1	0	1	0	0	0	0	0	0	2
Silver Bldg. Springs	0	0	0	0	0	0	0	0	0	0
Sucker Springs	0	0	0	0	0	0	0	0	0	0
Williamson River	0	0	0	4	2	0	1	0	0	7
Sprague River	0	0	0	0	3	0	2	0	0	5
Lower Lake	0	0	0	0	0	0	0	0	0	0
Middle Lake	0	0	0	0	0	0	5	0	1	6
Total	1	0	1	4	5	0	8	0	1	20



Appendix Figure A. Summary of the size range of Lost River suckers captured at shoreline sampling areas in Upper Klamath Lake, 1999, by date sampled.